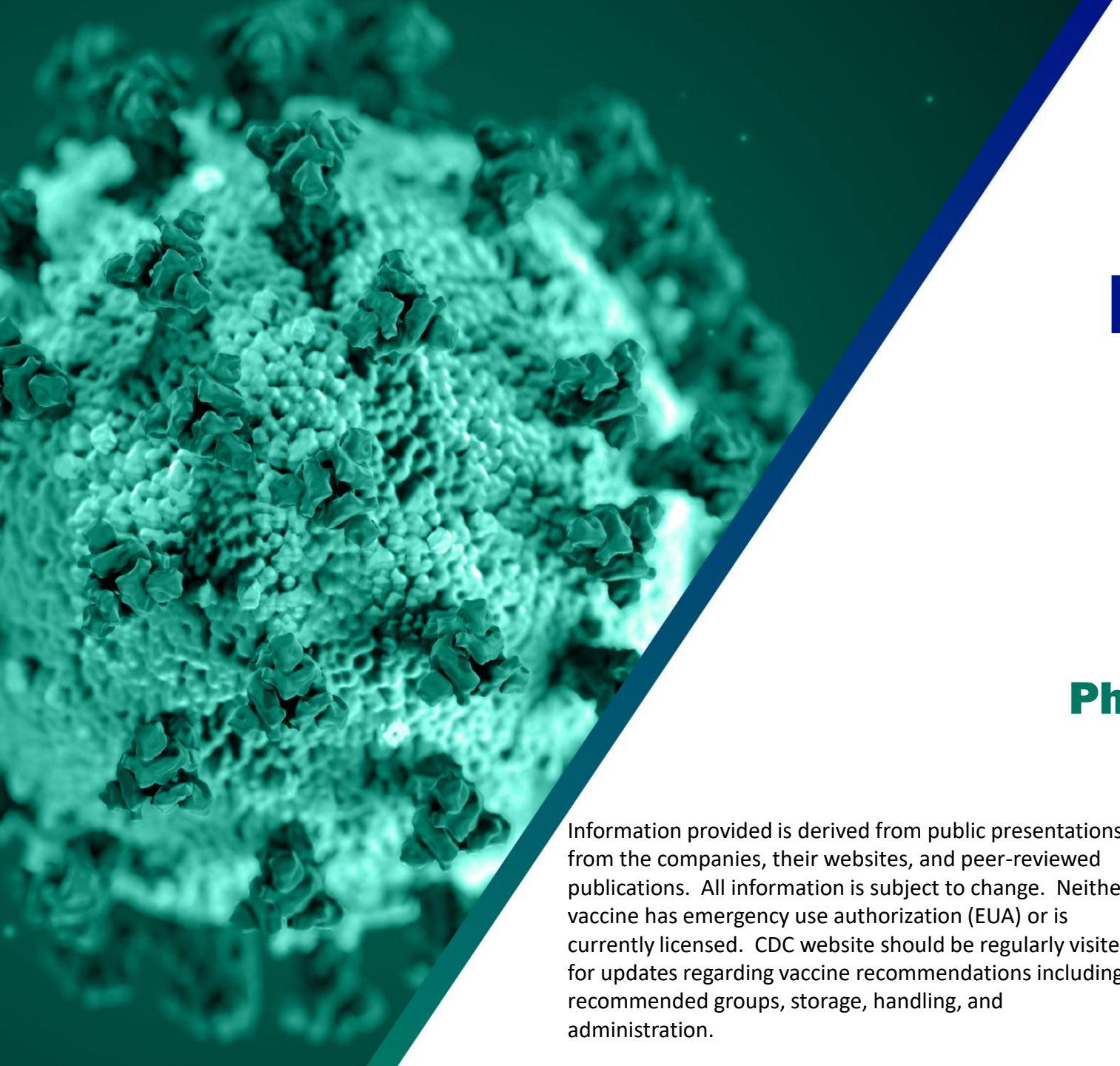


Overview of Pfizer/BioNTech and Moderna Vaccines, v1.

Carolyn B. Bridges, MD

Physician Consultant, Idaho Dept Health and Welfare

December 4, 2020

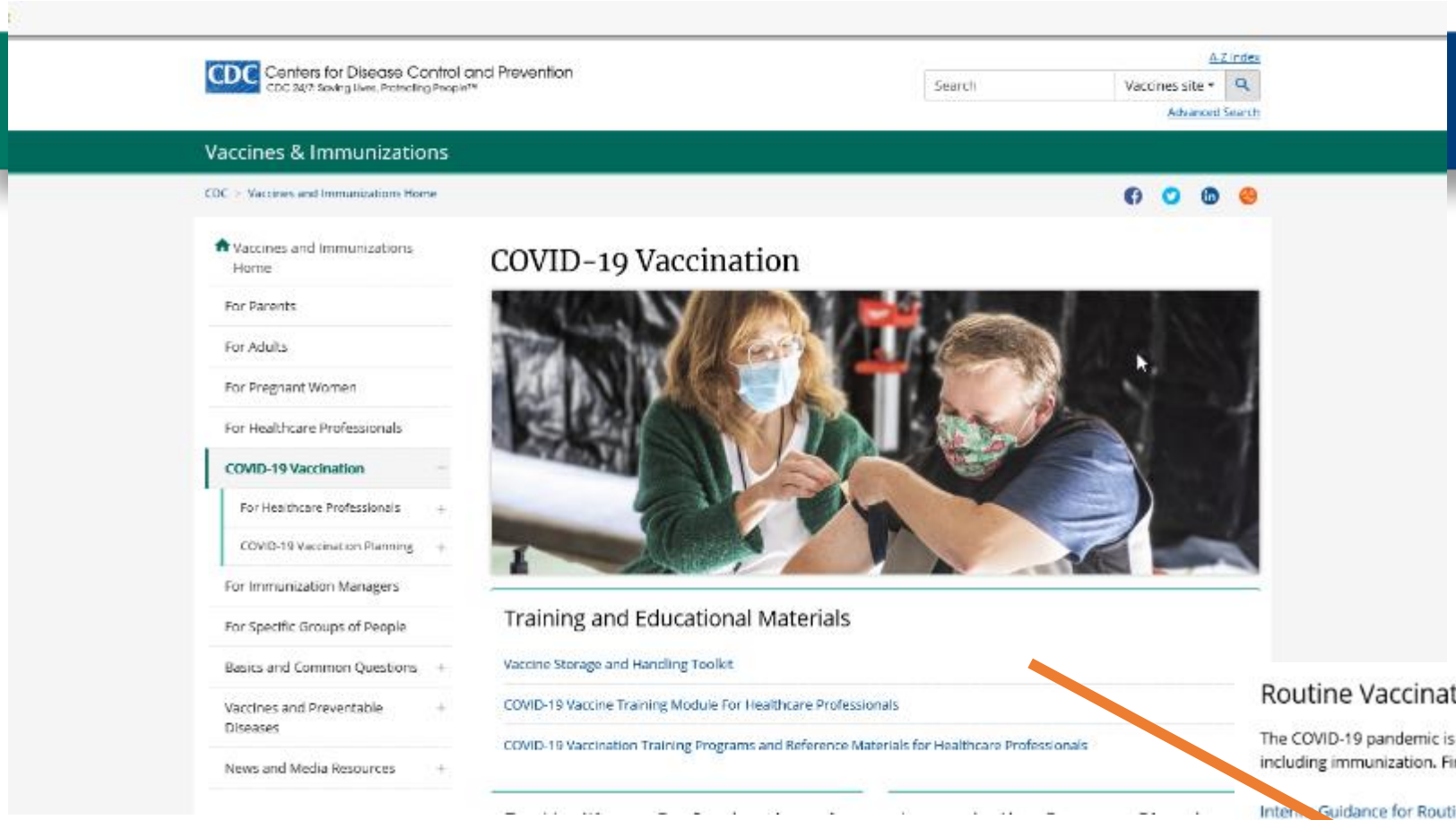
Information provided is derived from public presentations from the companies, their websites, and peer-reviewed publications. All information is subject to change. Neither vaccine has emergency use authorization (EUA) or is currently licensed. CDC website should be regularly visited for updates regarding vaccine recommendations including recommended groups, storage, handling, and administration.

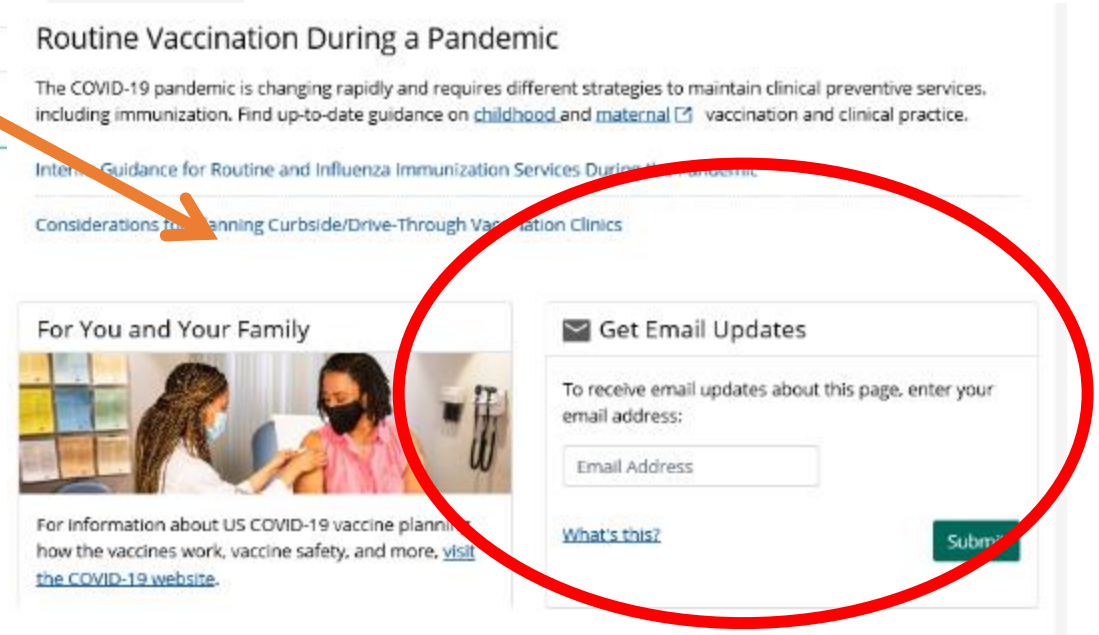
IDAHO DEPARTMENT OF HEALTH & WELFARE

Overview

- BioNTech/Pfizer and Moderna vaccines are the first COVID-19 vaccines expected to be available in the U.S.
  - Both are mRNA vaccines
  - Preliminary information from the manufactures indicates that BOTH vaccines are likely to be very effective.
  - The B/Pf vaccine in particular has significant cold-chain challenges that must be overcome in order to most effectively use this vaccine.
- Additional COVID-19 vaccines using different platforms are in development
- This presentation will highlight information currently available on vaccine storage and handling.
- CDC will provide public training materials once the vaccine(s) have an FDA emergency use authorization (EUA) and/or are licensed by FDA.
- Links to CDC training materials and future materials can be found at:

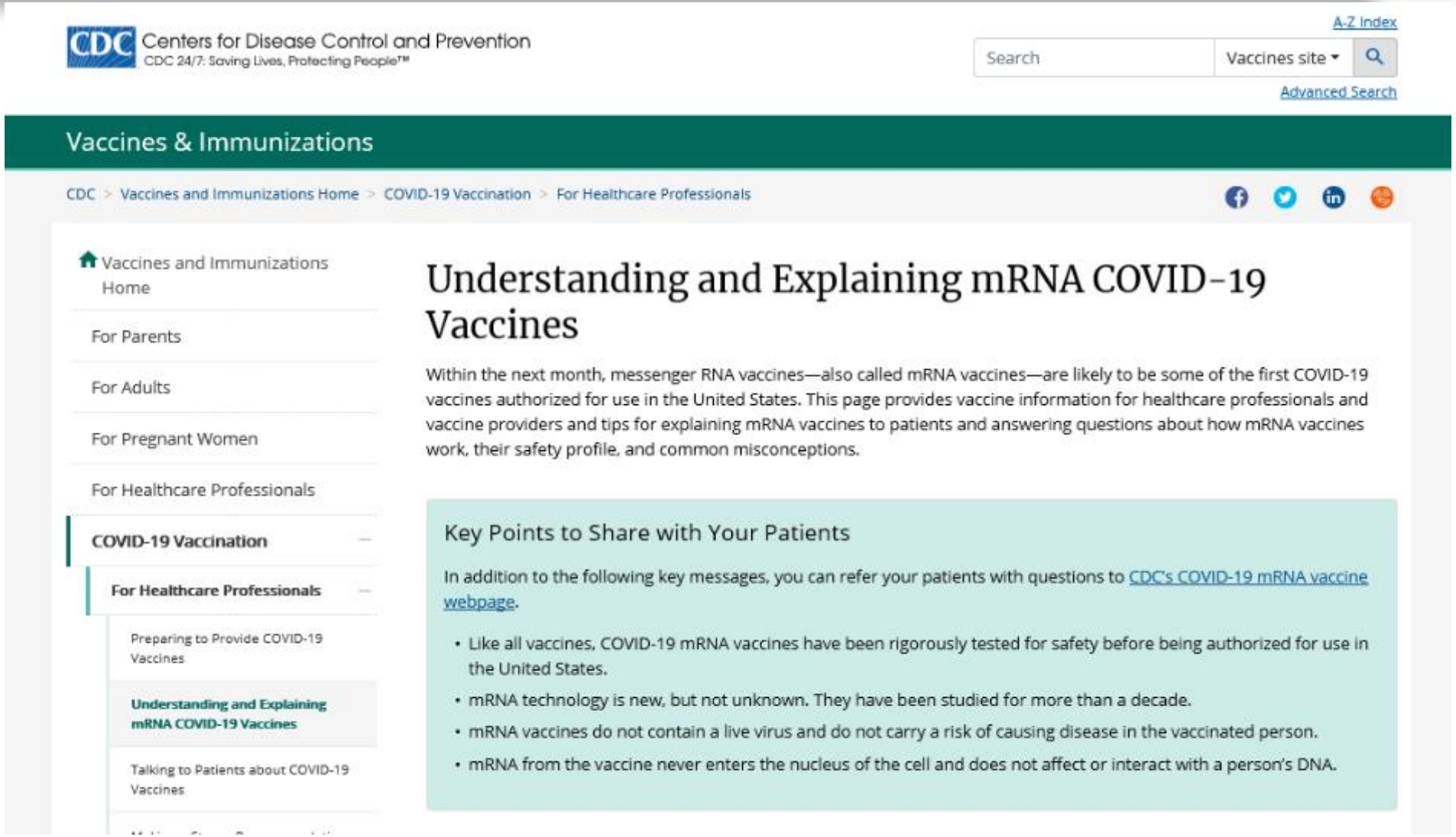
https://www.cdc.gov/vaccines/covid-19/downloads/COVID-19-Clinical-Training-and-Resources-for-HCPs.pdf





https://www.cdc.gov/vaccines/covid-19/index.html.

CDC Information on mRNA Vaccines



https://www.cdc.gov/vaccines/covid-19/hcp/mrna-vaccine-basics.html.

- Reviewed national epidemiology of COVID-19
- Presentations by Moderna and Pfizer/BioNTech on their phase 1 / 2 studies
- Full presentations from the companies can be found at: https://www.cdc.gov/vaccines/acip/meetings/slides-2020-08.html.

Immunogenicity and Safety Information Reviewed by Work Group

mRNA1273 (Moderna) N=130

- **Immunogenicity**
  - Neutralizing antibodies (pseudovirus neutralization assay titers) and binding antibodies (ELISA) measured 7 days post-dose 2
  - Responses similar to or exceeded convalescent sera comparison
  - Th1-biased CD4+ T-cell response
  - **100µg** dose selected for Phase III clinical trials

- **Safety**
  - Local and systemic symptoms followed for 7 days post-vaccination
    - Pain, myalgia, fatigue most common symptoms reported
  - Reactogenicity symptoms higher after second dose
  - No vaccine-related serious adverse events (SAEs) reported

Slide from ACIP meeting, August 26, 2020

Moderna mRNA Vaccine SARS-CoV-2 Antibody and Neutralization Responses. Dose escalation study in adults 18-45 years old. Jackson et al, NEJM 2020

Table 1. Characteristics of the Participants in the mRNA-1273 Trial at Enrollment.*

Characteristic	25-μg Group (N=15)	100-μg Group (N=15)	250-μg Group (N=15)	Overall (N=45)
Sex — no. (%)				
Male	9 (60)	7 (47)	6 (40)	22 (49)
Female	6 (40)	8 (53)	9 (60)	23 (51)
Age — yr	36.7±7.9	31.3±8.7	31.0±8.0	33.0±8.5
Race or ethnic group — no. (%)†				
American Indian or Alaska Native	0	1 (7)	0	1 (2)
Asian	0	0	1 (7)	1 (2)
Black	0	2 (13)	0	2 (4)
White	15 (100)	11 (73)	14 (93)	40 (89)
Unknown	0	1 (7)	0	1 (2)
Hispanic or Latino — no. (%)	1 (7)	3 (20)	2 (13)‡	6 (13)
Body-mass index§	24.6±3.4	26.7±2.6	24.7±3.1	25.3±3.2

* Plus–minus values are means ±SD.
† Race or ethnic group was reported by the participants.
‡ One participant did not report ethnic group.
§ The body-mass index is the weight in kilograms divided by the square of the height in meters. This calculation was based on the weight and height measured at the time of screening.

.Jackson LA, Anderson EJ, Rouphael NG, et al. An mRNA vaccine against SARS-CoV-2 – Preliminary report. N Engl J Med 2020;383:1920-31 https://www.nejm.org/doi/pdf/10.1056/NEJMoa2022483.

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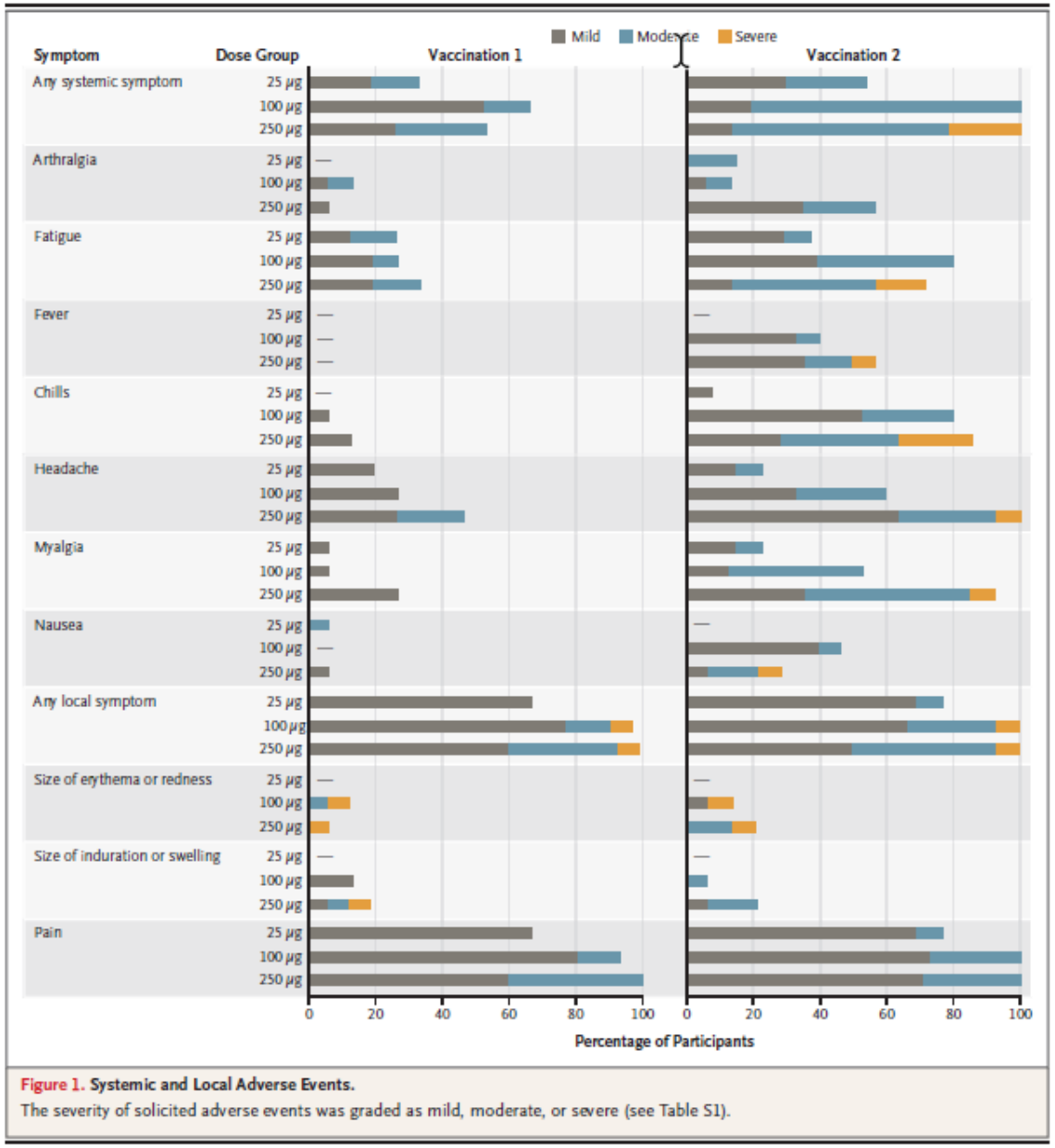
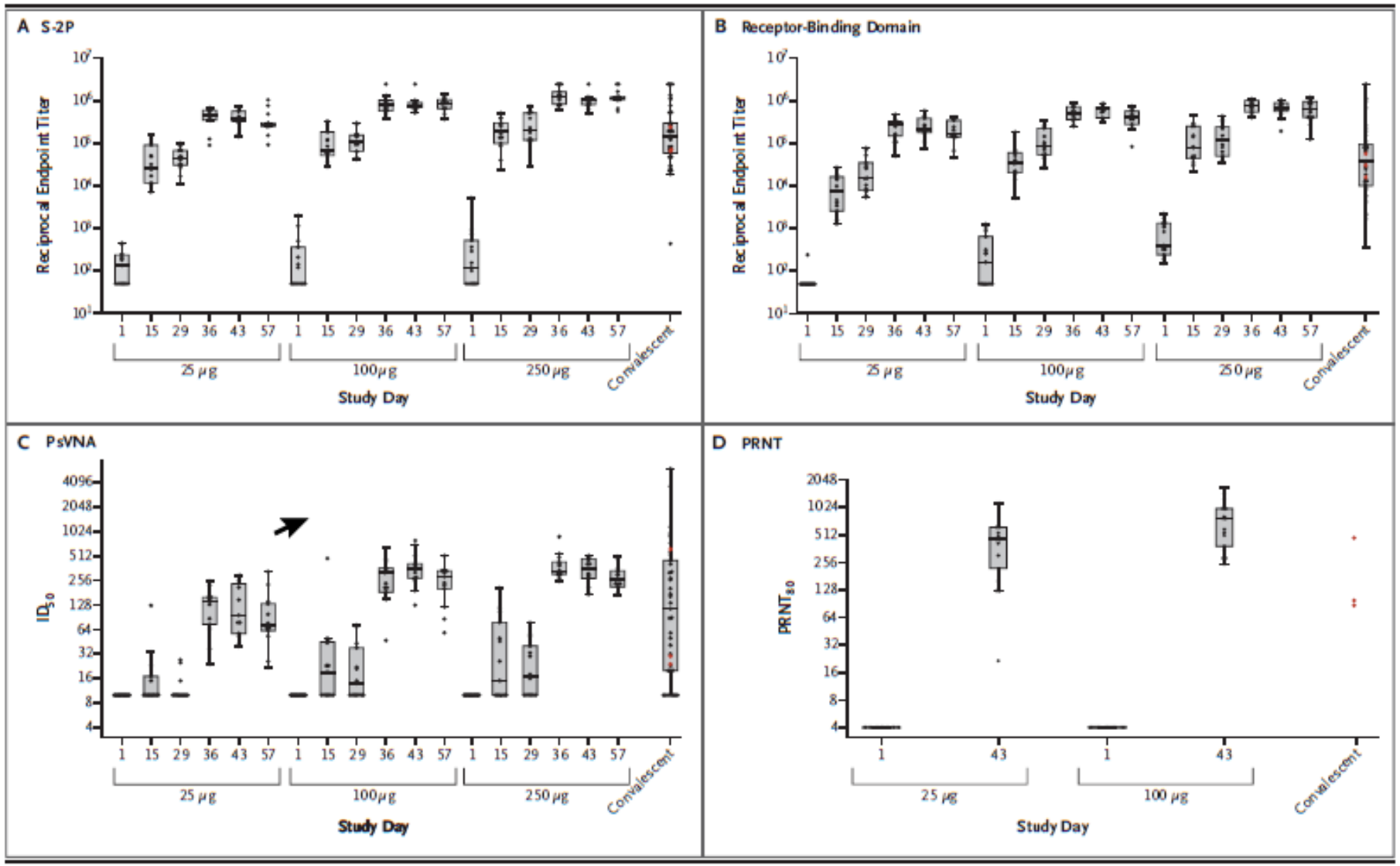


Figure 1. Systemic and Local Adverse Events.
The severity of solicited adverse events was graded as mild, moderate, or severe (see Table S1).

Moderna mRNA Vaccine SARS-CoV-2 Antibody and Neutralization Responses. Dose escalation study in adults 18-45 years old. Jackson et al, NEJM 2020



The NEW ENGLAND JOURNAL of MEDICINE

Moderna mRNA Vaccine SARS-CoV-2 Antibody and Neutralization Responses. Dose escalation study in adults 18-45 years old. Jackson et al, NEJM 2020. https://www.nejm.org/doi/pdf/10.1056/NEJMoa2022483

Safety and Immunogenicity of SARS-CoV-2 mRNA-1273 Vaccine in Older Adults

Evan J. Anderson, M.D., Nadine G. Rouphael, M.D., Alicia T. Widge, M.D., Lisa A. Jackson, M.D., M.P.H., Paul C. Roberts, Ph.D., Mamodikoe Makhene, M.D., M.P.H., James D. Chappell, M.D., Ph.D., Mark R. Denison, M.D., Laura J. Stevens, M.S., Andrea J. Pruijssers, Ph.D., Adrian B. McDermott, Ph.D., Britta Flach, Ph.D., et al., for the mRNA-1273 Study Group*

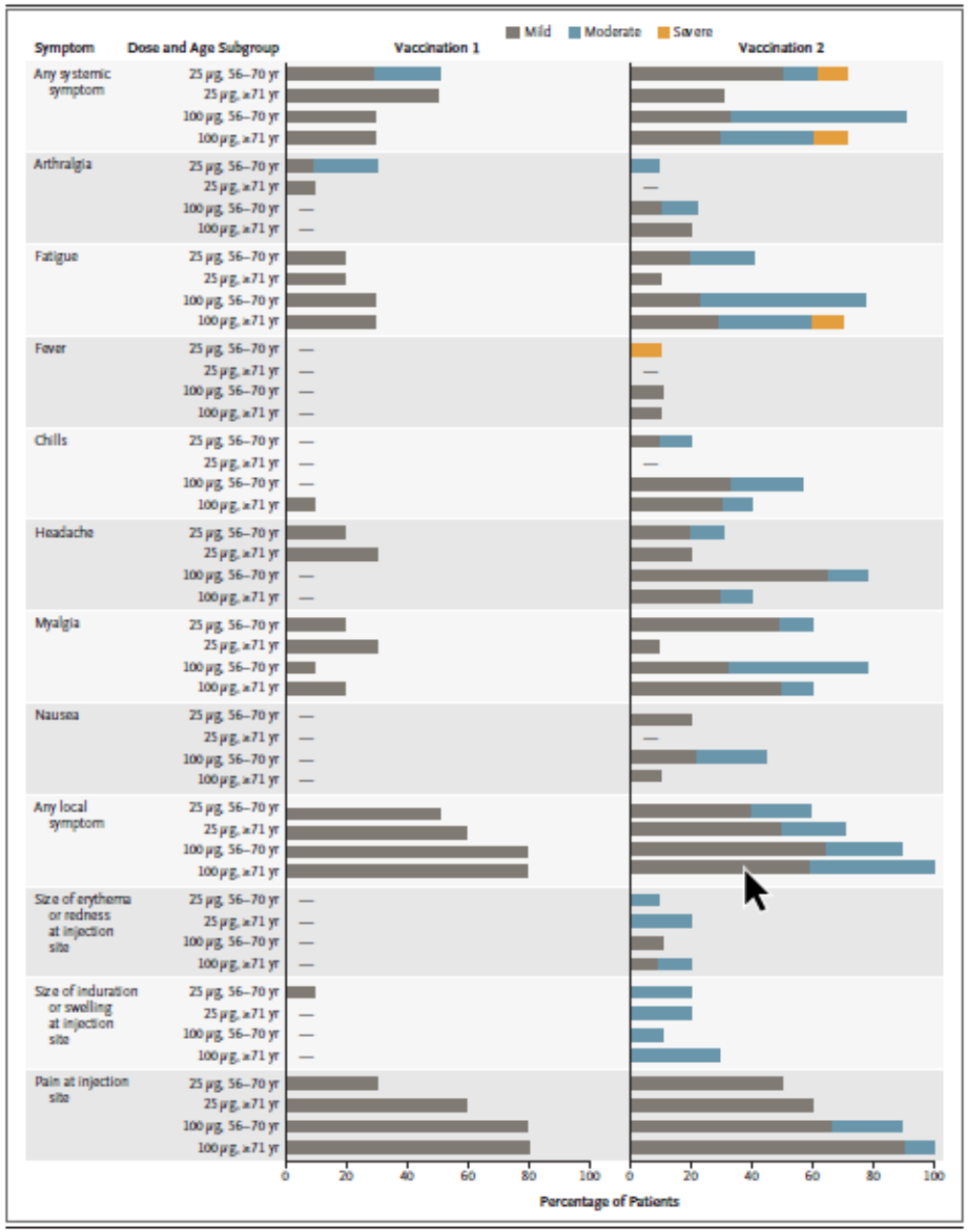
September 29, 2020
DOI: 10.1056/NEJMoa2028436

Table 1. Characteristics of the Participants at Baseline.*

Characteristic	Age of 56–70 Years		Age of ≥71 Years		All Participants (N=40)
	25-µg Dose (N=10)	100-µg Dose (N=10)	25-µg Dose (N=10)	100-µg Dose (N=10)	
Sex — no. (%)					
Male	3 (30)	5 (50)	8 (80)	3 (30)	19 (48)
Female	7 (70)	5 (50)	2 (20)	7 (70)	21 (52)
Age — yr	65.8±4.5	63.8±4.3	72.8±1.2	72.6±1.1	68.7
Race or ethnic group — no. (%)†					
Asian	0	0	1 (10)	0	1 (2)
White	10 (100)	10 (100)	9 (90)	10 (100)	39 (98)
Hispanic or Latino	0	0	1 (10)	0	1 (2)
Body-mass index‡	25.4±2.5	23.7±2.3	24.8±3.5	26.0±3.5	25.0±3.0

* Plus–minus values are means ±SD.
† Race or ethnic group was reported by the participants, who could select more than one category.

https://www.nejm.org/doi/10.1056/NEJMoa2028436.

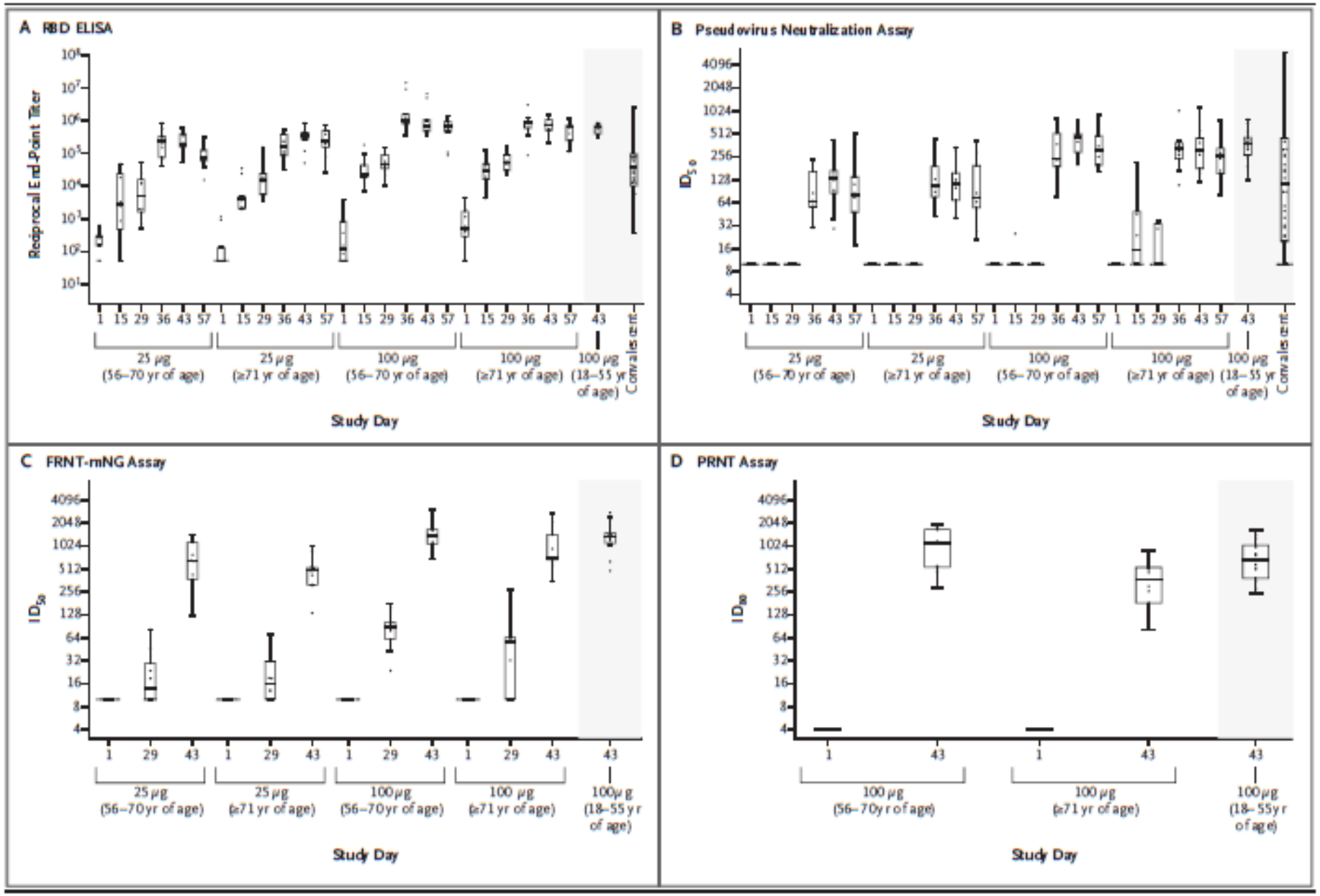


Moderna mRNA Vaccine Clinical Trial Among Adults 56-70 years vs ≥71 years old.

Systemic and Local Adverse Events.

Anderson, et al. NEJM 2020

https://www.nejm.org/doi/10.1056/NEJMoa2028436.



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Anderson, et al. NEJM 2020

https://www.nejm.org/doi/10.1056/NEJMoa2028436

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Immunogenicity and Safety Information Reviewed by Work Group

BNT162b2 (Pfizer/BioNTech) N=195

- **Immunogenicity**
  - Neutralizing antibodies (50% neutralization titers) measured 7 days post-dose 2
  - Responses similar to or exceeded human convalescent panel
  - CD4+ and CD8+ T cell response demonstrated
  - Th1-biased CD4+ T-cell response
  - **30µg** dose of BNT162b2 selected for Phase III clinical trials

- **Safety**
  - Local and systemic symptoms followed after administration
    - Fatigue, headache and muscle pain most common
  - Reactogenicity symptoms lower in older population (65-85 years)

Slide from ACIP meeting, August 26, 2020

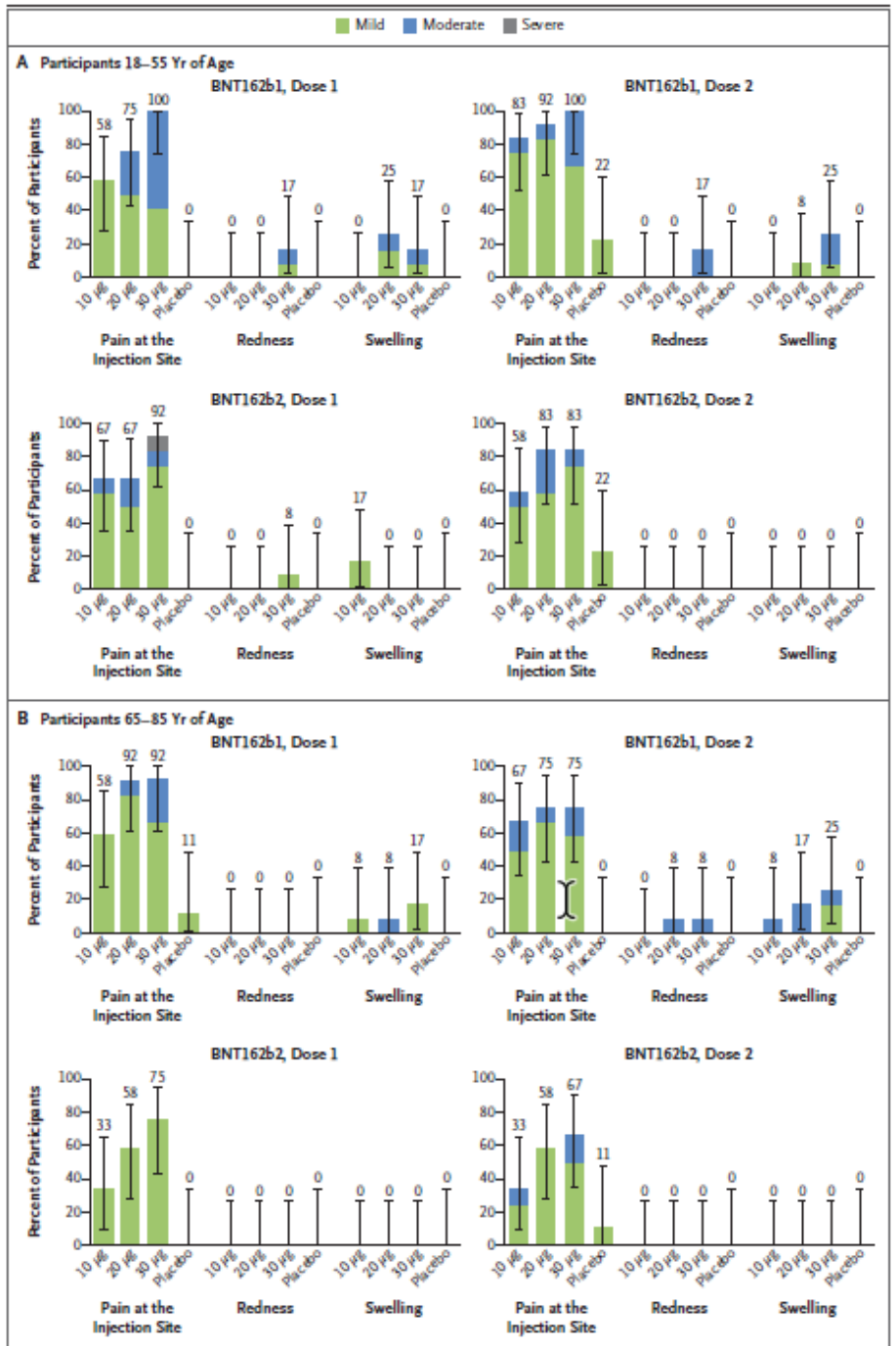
Table 1. Demographic Characteristics of the Participants, According to Vaccine Candidate and Age Group.*

Variable	Participants 18–55 Years of Age						Participants 65–85 Years of Age				
	10 μg	20 μg	30 μg	100 μg	Placebo	Total	10 μg	20 μg	30 μg	Placebo	Total
BNT162b1											
No. of participants	12	12	12	12	12	60	12	12	12	9	45
Sex — no. (%)											
Male	7 (58)	9 (75)	6 (50)	5 (42)	7 (58)	34 (57)	4 (33)	4 (33)	4 (33)	1 (11)	13 (29)
Female	5 (42)	3 (25)	6 (50)	7 (58)	5 (42)	26 (43)	8 (67)	8 (67)	8 (67)	8 (89)	32 (71)
Race — no. (%)†											
White	8 (67)	11 (92)	10 (83)	11 (92)	11 (92)	51 (85)	12 (100)	11 (92)	10 (83)	9 (100)	42 (93)
Black	1 (8)	1 (8)	0	0	0	2 (3)	0	1 (8)	0	0	1 (2)
Asian	3 (25)	0	2 (17)	1 (8)	1 (8)	7 (12)	0	0	2 (17)	0	2 (4)
Hispanic ethnic group — no. (%)†	1 (8)	0	1 (8)	0	0	2 (3)	0	0	0	1 (11)	1 (2)
Age — yr‡											
Mean	29.4±6.4	44.8±8.3	35.8±10.0	38.3±9.3	36.3±11.3	36.9±10.2	69.7±5.4	70.6±4.9	69.9±3.6	68.2±3.0	69.7±4.3
Median (range)	26.5 (24–42)	49.0 (30–54)	33.5 (23–52)	38.0 (25–53)	35.0 (19–54)	35.0 (19–54)	68.5 (65–82)	69.0 (65–81)	69.0 (65–77)	68.0 (65–73)	69.0 (65–82)
BNT162b2											
No. of participants	12	12	12	0	9	45	12	12	12	9	45
Sex — no. (%)											
Male	5 (42)	6 (50)	3 (25)	—	5 (56)	19 (42)	2 (17)	5 (42)	6 (50)	4 (44)	17 (38)
Female	7 (58)	6 (50)	9 (75)	—	4 (44)	26 (58)	10 (83)	7 (58)	6 (50)	5 (56)	28 (62)
Race — no. (%)†											
White	11 (92)	10 (83)	9 (75)	—	9 (100)	39 (87)	12 (100)	12 (100)	12 (100)	9 (100)	45 (100)
Black	0	2 (17)	1 (8)	—	0	3 (7)	0	0	0	0	0
Asian	1 (8)	0	2 (17)	—	0	3 (7)	0	0	0	0	0
Hispanic ethnic group — no. (%)†	1 (8)	1 (8)	0	—	0	2 (4)	0	0	0	0	0
Age — yr‡											
Mean	36.8±12.2	37.6±10.1	37.3±9.8	—	34.4±13.2	36.7±11.0	68.0±2.9	71.0±5.8	68.5±2.8	70.0±3.8	69.3±4.1
Median (range)	37.0 (21–53)	38.0 (23–53)	36.5 (23–54)	—	30.0 (19–53)	37.0 (19–54)	67.0 (65–73)	68.5 (65–81)	68.0 (65–74)	69.0 (65–77)	68.0 (65–81)

* Plus–minus values are means ±SD. Percentages may not total 100 because of rounding.
† Race and ethnic group were reported by the participant.
‡ The age of the participants was the age at the time of the injection.

Walsh EE, et al. NEJM 2020.
mRNA-Based COVID-19 Vaccine safety and immunogenicity study.

doi.org10.1056/NEJMoa2027906.



Walsh EE, et al. NEJM 2020.
RNA-Based COVID-19 Vaccine safety and immunogenicity study.

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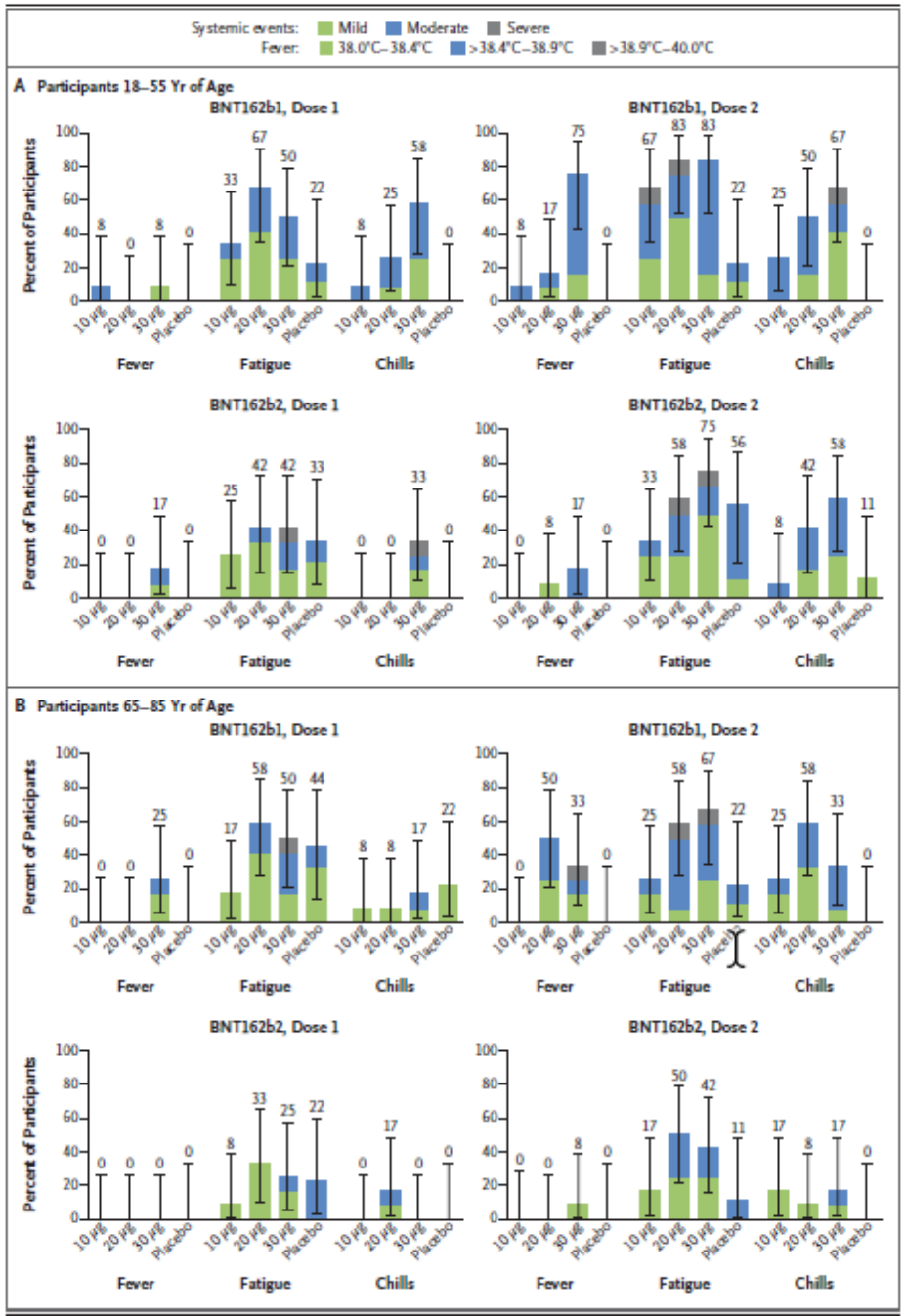
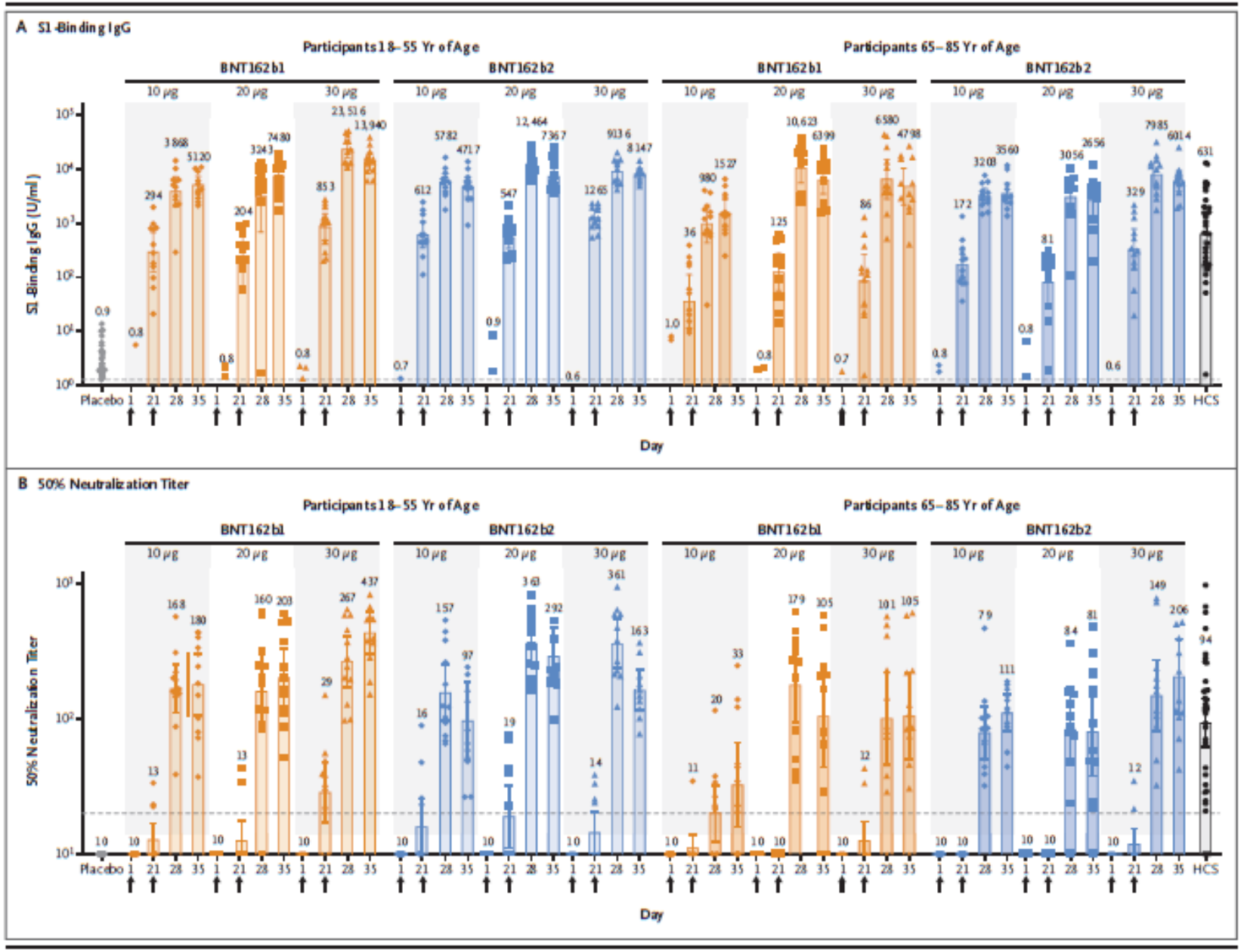


Walsh EE, et al. NEJM 2020. mRNA-Based COVID-19 Vaccine safety and immunogenicity study. doi.org10.1056/NEJMoa2027906.



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Walsh EE, et al. NEJM 2020. mRNA-Based COVID-19 Vaccine safety and immunogenicity study. doi.org10.1056/NEJMoa2027906.

	ModernaTX USA	BioNTech with Pfizer
Vaccine / type	mRNA-1273	BNT162-b2 mRNA
Dosing	Days 0 + 28	Days 0 + 21
Ages studied	18+ yrs.	12-85 yrs. (n=100 12-15 yo)
EUA Submitted	Nov. 30, 2020	Nov. 20, 2020
VRBPAC Mtg	~Dec. 17, 2020	Dec. 10, 2020
Prelim. Est. Vaccine effectiveness*	94% against PCR+ COVID (196 cases); 100% severe COVID (30 cases)	95% vs PCR+ COVID (170 cases); 90% severe COVID (9 vs 1 case)
Safety	Most AE mild to moderate. Grade 3: fatigue 9.7%, muscle ache 8.9%, joint pain 5.2%, headache 4.5%, pain 4.1%	Most AE mild to moderate. Grade 3 that were 2% or greater: fatigue 3.8%; headache 2.0%.
Vaccine Production Estimates	*"end of 2020, …20 million doses … in U.S. …500 million to 1 billion doses globally in 2021"*	*"globally up to 50 million vaccine doses in 2020 and up to 1.3 billion doses by the end of 2021"*

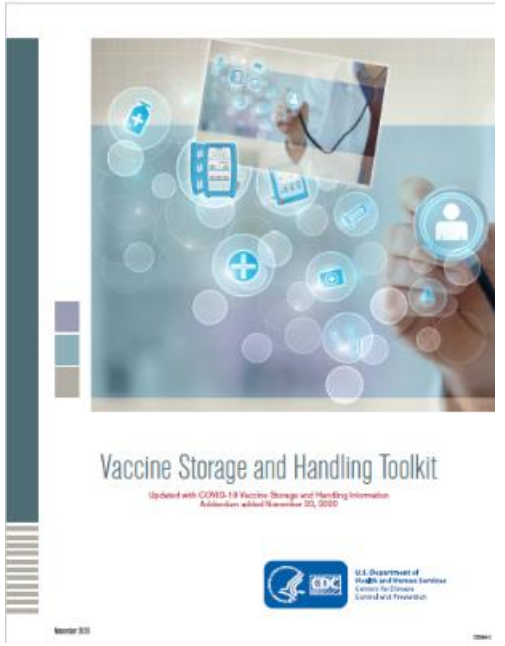
*Publicly reported information. Subject to change.

	ModernaTX USA	BioNTech with Pfizer
Shipping and storage temp.	-20C	-70/-75 C (dry ice)
Days at 2-8C	30 days MAX	5 days MAX
Time at room temp	≤12 hours MAX	≤ 2 hours
Refreeze?	NO	NO
Doses per shipment	100 minimum	975 minimum
Doses per vial	10	5
Reconstitute	NO	1.8 mL of 0.9% NaCl injection USP– one 2 mL NaCl vial per vaccine vial
Use time	6 hrs after vial punctured	6 hours after reconstitution
Route	Intramuscular	Intramuscular
Needle size	Adults 1-1 ½ inches	Adults 1-1 ½ inches

*Publicly reported information. Subject to change.

COVID-19 Vaccine Provider Agreement S&H Requirements

- Store and handle COVID-19 vaccines under proper conditions, including maintaining cold chain conditions and chain of custody at all times in accordance with an EUA or vaccine package insert, manufacturer guidance, and CDC guidance.
- Monitor storage unit temperatures at all times, using equipment and practices that comply with guidance in this toolkit.
- Comply with immunization program guidance for handling temperature excursions.
- Monitor and comply with COVID-19 vaccine expiration dates.
- Preserve all records related to COVID-19 vaccine management for a minimum of three years.
- Comply with federal instructions and timelines for disposing of COVID-19 vaccine and diluent, including unused doses.



https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/storage-handling-toolkit.pdf.

CDC Vaccine Storage and Handling Toolkit

General Transport System Recommendations	Emergency Transport	Transport for Off-Site Clinic, Satellite Facility, or Relocation of Stock
Portable Vaccine Refrigerator, Freezer, or Ultra-cold Freezer	Yes	Yes
Qualified Container and Packout	Yes	Yes
Conditioned Water Bottle Transport System	Yes	No
Manufacturer's Original Shipping Container	Yes (last resort only)	No*
Food/Beverage Coolers	No	No

*The original shipping container for ultra-cold COVID-19 vaccine can be used for transport.

Each vaccine storage unit needs a temperature monitoring device (TMD) to ensure that vaccines are stored within the correct temperature range. CDC recommends a specific type of TMD called a "digital data logger" (DDL). A DDL details on how long a unit has been operating outside the recommended temperature range (referred to as a "temperature excursion").

Min and Max temperatures must be checked and recorded two times each workday—at the beginning and end of the day.

DDLs for Ultra-Cold Temperatures

DDLs using a buffered temperature probe provide the most accurate measurement of vaccine temperatures. However, many manufacturers use pure propylene glycol (freezing point -59° C) or a glycol mixture with a warmer freezing point. For accurate ultra-cold temperature monitoring, it is essential to use an air-probe or a probe designed specifically for ultra-cold temperatures with the DDL.

Monitoring Temperatures

- Storage unit temperatures must be checked and recorded at the start of each workday – twice daily if DDL does not record minimum and maximum temperatures.
- Always record:
  - Minimum/maximum temperature
  - Date
  - Time
  - Name of person checking and recording temperature
  - Actions taken if a temperature excursion occurred
- Temperature records must be kept for a minimum of three years

Chart 3: Vaccine B storage and handling guide

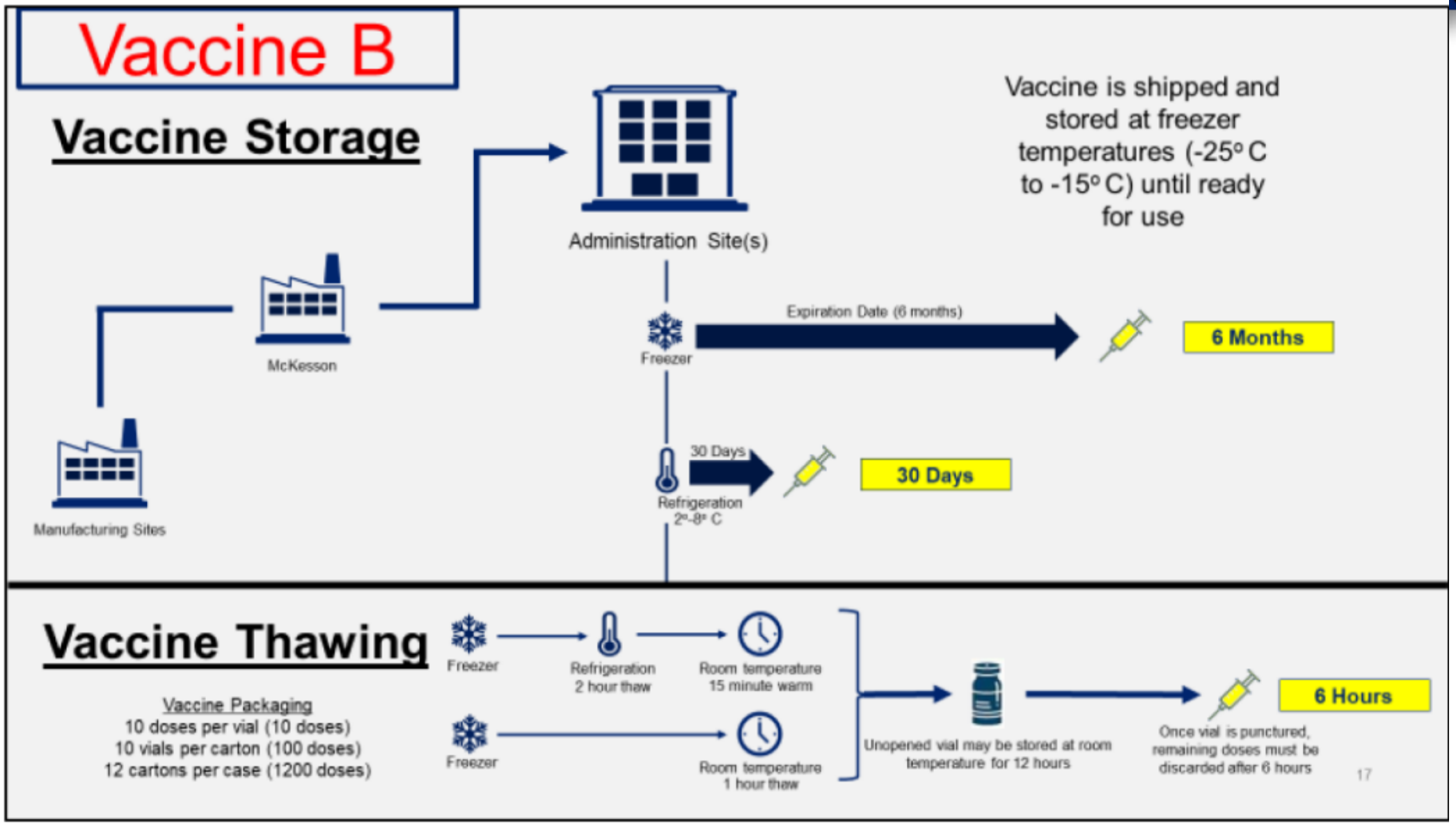
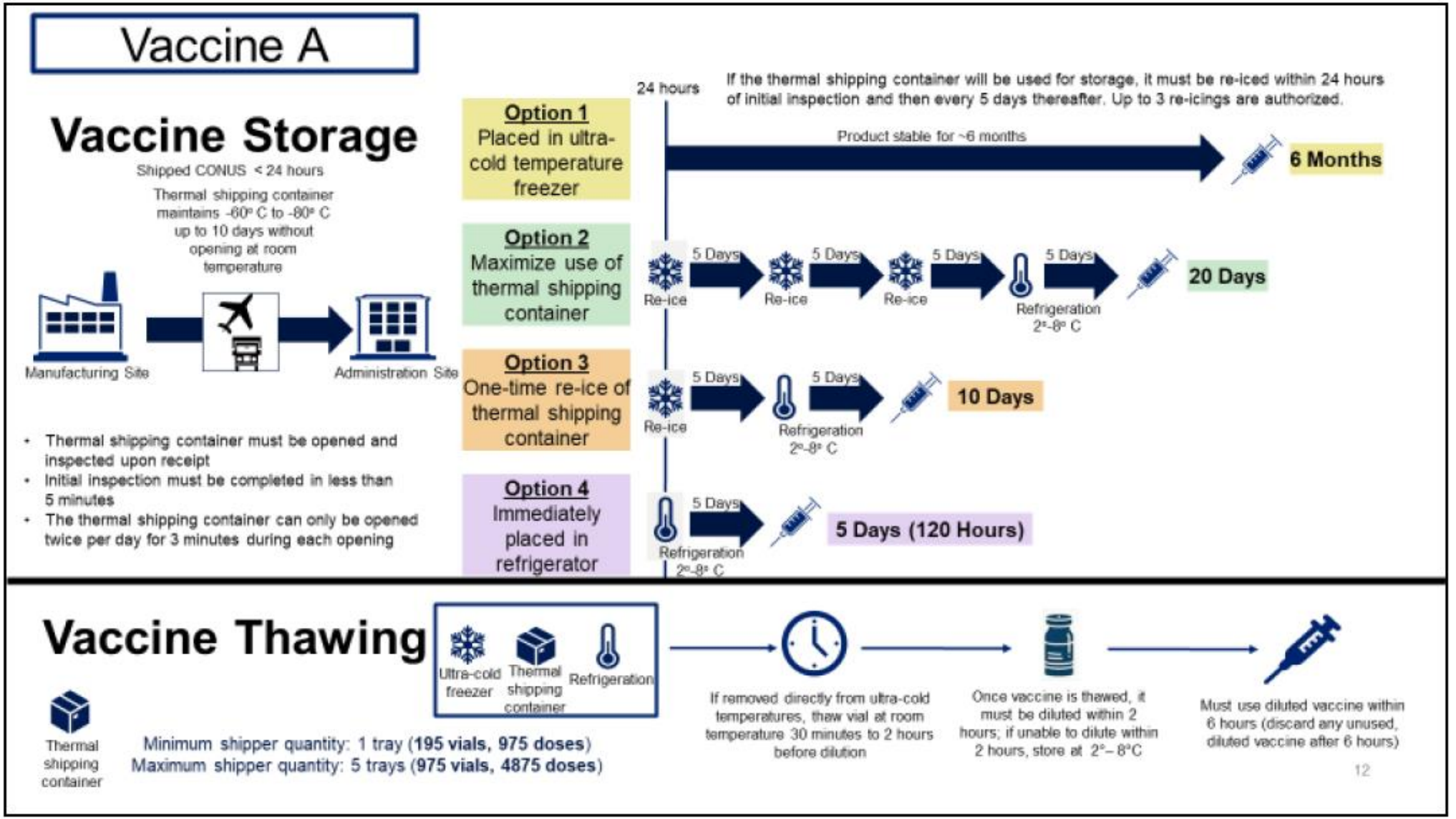


Chart 1: Vaccine A storage and handling guide



BioNTech/Pfizer Vaccine Storage and Handling

Product Packaging Overview

1 Primary Packaging

- 2 mL type 1 glass preservative free multi-dose vial (MDV)
- MDV has 0.45 mL frozen liquid drug product
- 5 doses per vial after dilution

2 Secondary Packaging "Single Tray"

- Single tray holds 195 vials
- 975 doses per tray
- A smaller tray, containing 25 vials (125 doses) is in development with estimated availability in early 2021

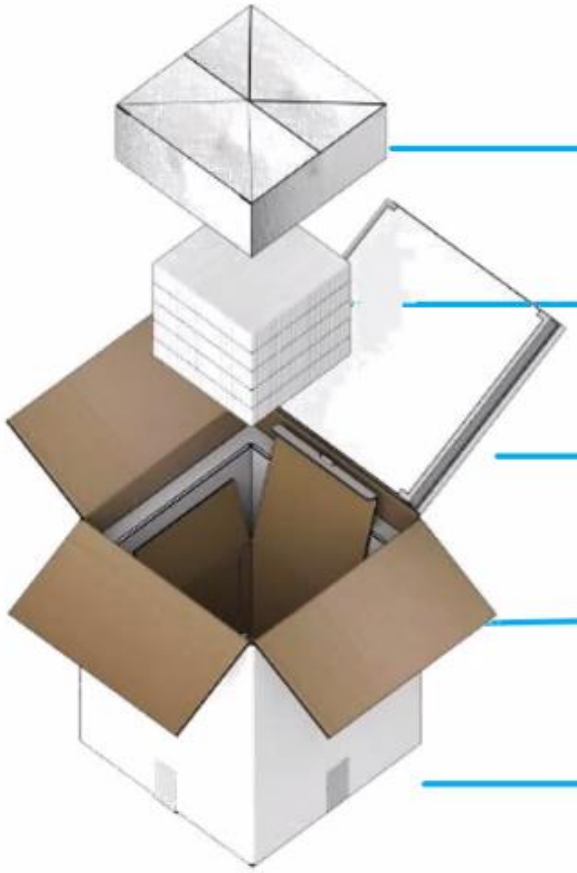
3 Tertiary Container: Thermal Shipper

Item	Description
1	Dry Ice Pod
2	Vial Trays
3	Inner Lid
4	Payload box (holds vial trays)
5	Outer Carton

- Minimum 1 tray (975 doses) or up to 5 trays (4875 doses) stacked in a payload area of the shipper
- Payload carton submerged in dry ice pellets
- Thermal shipper keeps ULT (-75±15°C) up to 10 days if stored at 15°C to 25°C temperatures without opening.
- Thermal shippers are reusable and designed to be a temporary storage containers by replenishing dry ice

BioNTech/Pfizer Vaccine Storage and Handling

Ultra Low Temperature Thermal Shipper – Overview of Pack Out



ITEM	DESCRIPTION
1	DRY ICE POD
2	VIAL TRAYS
3	INNER LID
4	PAYLOAD BOX (Holds vial trays)
5	OUTER CARTON

Weights and Dimensions	
Tare Weight (Inc. Dry-Ice)	8.5kg (31.5kg)
Volumetric Weight	15.0kg
Payload Space L x W x H	245x245x241mm
Shipper Dimensions L x W x H	400x400x560mm

Vaccination Supplies Shipped to Providers

COVID-19 Vaccine Ancillary Supplies

COVID-19 vaccine shipments will include ancillary supplies:

- Needles (various sizes for the population served)
- Syringes
- Alcohol prep pads
- Surgical masks and face shields for vaccinators
- COVID-19 vaccination record cards for vaccine recipients
- Vaccine needle and length guide
- Diluent and mixing supplies (based on vaccine product)

https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/index.html.

Vaccine Administration Best Practices

- Prepare vaccines in a designated area away from any space where potentially contaminated items are placed.
- Always follow the manufacturer's instructions for preparing vaccine.
- Only prepare vaccines when you are ready to administer them.
- Always check expiration dates. If your facility stocks multiple vaccine products, always confirm you have selected the correct vaccine.
- Only administer vaccines you have prepared. This is a quality control and patient safety issue and a best practice standard of medication administration.

Predrawing vaccine can result in waste when more is drawn up than needed. In the rare instances when it is necessary to predraw vaccines, it is important to follow recommended guidance to avoid compromising and wasting vaccine and to maintain the cold chain. Carefully follow the toolkit best practices for predrawing vaccine as well as any manufacturer guidance.

https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/index.html.

Vaccine Safety Monitoring - V-Safe Text-based System for the Public

- Many existing vaccine safety monitoring systems will be used and enhanced for monitoring the safety of COVID-19 vaccines, e.g. Vaccine Adverse Events Reporting System (VAERS) and Vaccine Safety Datalink

- CDC is asking COVID-19 vaccine providers to encourage enrollment in v-safe when they get their first vaccine dose
  - Will provide prospective information on adverse events

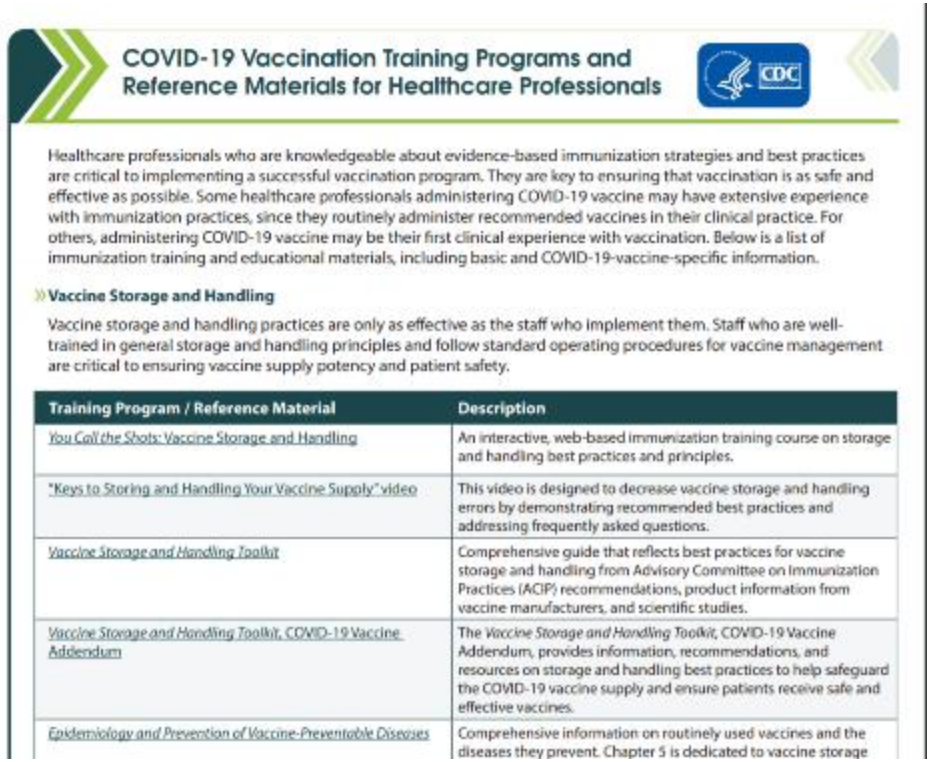
- More information about vaccine safety systems and also about V-safe can be found at: https://www.cdc.gov/vaccines/acip/meetings/downloads/slides-2020-09/COVID-03-Shimabukuro.pdf.

- Updated CDC storage and handling tool kit with new section on COVID-19 vaccine
  - https://www.cdc.gov/vaccines/hcp/admin/storage/toolkit/storage-handling-toolkit.pdf.

- List of CDC resources and training on COVID-19 vaccine
  - https://www.cdc.gov/vaccines/covid-19/index.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fvaccines%2Fcovid-19%2Fvaccination-resources.html.

Main CDC page for COVID-19 vaccine

https://www.cdc.gov/vaccines/covid-19/index.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fvaccines%2Fcovid-19%2Fvaccination-resources.html.



COVID-19 Vaccination Training Programs and Reference Materials for Healthcare Professionals

Healthcare professionals who are knowledgeable about evidence-based immunization strategies and best practices are critical to implementing a successful vaccination program. They are key to ensuring that vaccination is as safe and effective as possible. Some healthcare professionals administering COVID-19 vaccine may have extensive experience with immunization practices, since they routinely administer recommended vaccines in their clinical practice. For others, administering COVID-19 vaccine may be their first clinical experience with vaccination. Below is a list of immunization training and educational materials, including basic and COVID-19-vaccine-specific information.

Vaccine Storage and Handling

Vaccine storage and handling practices are only as effective as the staff who implement them. Staff who are well-trained in general storage and handling principles and follow standard operating procedures for vaccine management are critical to ensuring vaccine supply potency and patient safety.

Training Program / Reference Material	Description
You Call the Shots: Vaccine Storage and Handling	An interactive, web-based immunization training course on storage and handling best practices and principles.
"Keys to Storing and Handling Your Vaccine Supply" video	This video is designed to decrease vaccine storage and handling errors by demonstrating recommended best practices and addressing frequently asked questions.
Vaccine Storage and Handling Toolkit	Comprehensive guide that reflects best practices for vaccine storage and handling from Advisory Committee on Immunization Practices (ACIP) recommendations, product information from vaccine manufacturers, and scientific studies.
Vaccine Storage and Handling Toolkit, COVID-19 Vaccine Addendum	The *Vaccine Storage and Handling Toolkit*, COVID-19 Vaccine Addendum, provides information, recommendations, and resources on storage and handling best practices to help safeguard the COVID-19 vaccine supply and ensure patients receive safe and effective vaccines.
Epidemiology and Prevention of Vaccine-Preventable Diseases	Comprehensive information on routinely used vaccines and the diseases they prevent. Chapter 5 is dedicated to vaccine storage